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An assessment of benthic habitat impacts and unaccounted mortality in the Atlantic herring purse seine fishery on the northeast coast of Prince Edward Island

Une évaluation des impactes sur l'habitat benthique et de la mortalité par pêche non-comptabilisé dans la pêcherie à la seine en bourse pour le hareng de l'Atlantique le long de la côte nord-est de l'Île du Prince Édouard

Hugues P. Benoît and Claude LeBlanc

Marine Fish Section / Section des poisons marins
Gulf Fisheries Centre / Centre des Pêches du Golfe
Fisheries and Oceans Canada / Pêches et Océans Canada
343 avenue Université
P.O. Box 5030 / C.P. 5030
Moncton (NB)
E1C 9B6

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ABSTRACT

In this document, we provide an evaluation of possible benthic habitat impacts and unaccounted mortality in the southern Gulf of St. Lawrence fall herring purse seine fishery. Results are based on data collected by at-sea observers in 2004. Purse seines appeared to rarely touch the sea floor in over 100 observed fishing sets. This result is consistent with active avoidance on the part of fishers aiming to prevent net damage. Before catches are brought aboard in this fishery, a small sample of fish is taken by dip net to obtain measurements of fish body size. When a catch is felt to comprise a high proportion of fish of undesirable sizes, it is released entirely. Indicators of post-release survival recorded for 17 released sets suggest that survival was high.

RÉSUMÉ

Dans ce document, nous fournissons une évaluation des impactes possibles sur l'habitat benthique et de la mortalité non comptabilisée de la pêche du hareng à la senne en bourse de l'automne dans le Sud du golfe du Saint-Laurent. Les résultats sont fondés sur les données recueillies par les observateurs en mer en 2004. Les seines en bourses semblaient rarement toucher le plancher océanique dans plus de 100 traits de pêches observés. Ce résultat est conforme à l'évitement actif de la part des pêcheurs visant à prévenir les dommages au filet. Dans ce type de pêche, avant que les captures soient embarquées, un petit échantillon de poisson est pris par épuisette afin de mesurer la taille du poisson. Lorsqu'on croit qu'une capture contient une proportion élevée de poisson d'une taille indésirable, la capture en entier est libérée. Les indicateurs de survie après la libération consignés pour 17 calées libérées semblent indiquer que le taux de survie est élevé.

INTRODUCTION

Fisheries and Oceans Canada (DFO) convened a science advisory meeting in Ottawa on January 11-14, 2010, to assemble available information on the uses of longlines, gillnets, and miscellaneous fishing gears (e.g. purse seines, traps, pots, weirs, etc.) in Canadian waters, to examine the impacts of these gears on biodiversity and marine habitats, and to provide scientifically-based recommendations regarding potential avoidance or mitigation of these impacts where, required and feasible. In this report, which was prepared for that meeting, we present an evaluation of possible benthic habitat impacts and unaccounted mortality in the herring purse seine fishery on the northeast coast of Prince Edward Island (PEI), based on data collected by at-sea observers during the 2004 fall fishery.

BACKGROUND

There has been a longstanding conflict between gillnet and purse seine components of the southern Gulf of St. Lawrence herring fishery. Fish harvesters in the gillnet fleet, many of whom also fish for lobster, have accused the seiners of destroying benthic habitats with their gear, thereby potentially impairing the productivity of those habitats and the recruitment success of the herring, which lays its eggs on the sea floor. The gillnet harvesters were most concerned about impacts in waters <20 fathoms. Furthermore they believed that mortality was high for herring that are captured by the seine but released due to inadequate size. The purse seiners have maintained that they operated their gear so as to avoid touching the bottom and damaging their fishing gear, and that survival of released fishes was high. In response to this conflict, DFO initiated in 2004 a study of the bottom contact and post-release mortality of herring aboard the active purse seine vessels fishing along the northeast coast of PEI (Northwest Atlantic Fisheries Organization, NAFO, division 4Tg) during the autumn. While this study was intended to last for three years, changes in fishing regulations in 2005 that excluded the purse seiners from waters <25 fathoms largely put an end to the active conflict as well as the need for continued studies.

METHODS AND MATERIALS

There was complete coverage by certified third party at-sea observers during the 2004 purse seine fishery (October and November, 2004). In addition, DFO scientific staff participated in a number of those trips.

During all trips, frequency of bottom contact was assessed by two methods. First, observers examined the vessel's gear sensor monitor as the gear was deployed and noted whether it was possible that the gear had touched bottom. Second the observers examined the composition of the purse seine catch for evidence of the capture of bottom-dwelling species such as lobster.

The post release survival of undersized herring was also assessed. During typical fishing operations the seine is deployed and loosely pursed. A small sample of the catch is obtained using a dip net, and the seine is opened to release the catch if the composition of captured herring is felt to be undersized. During the 2004 fishery, 17 out of 105 sets were released. Following the release, observers noted whether there was apparent mortality of released herring using a semi-quantitative index ranging from 0 (no dead fish observed on the surface) to 10 (very high number of dead fish). Likewise the observers noted the abundance of herring scales on the water surface, an indicator of potential injury and therefore delayed mortality. Finally,

they also noted how tightly the seine was originally closed prior to dip-netting, on a scale from 1 (loose) to 10 (very tight).

There are two spawning components for NAFO 4T herring, one that spawns in the spring and a second that spawns in the fall. A representative sample of fish was retained from monitored sets for determination of the spawning component and age of individual fish in the laboratory. Spawning component attribution is determined by an examination of the otoliths and gonads (Cleary et al. 1982).

RESULTS

There were five active purse-seining vessels operating in NAFO 4Tg in the fall of 2004. A total of 105 purse seine sets were undertaken, mostly in the >20 fathom zone, where close to 80% of catches were made (Table 1). Four of 13 sets were released in the 17 to 20 fathom zone and 13 of 92 were released in the other zone. In addition 15 sets in the >20 fathom zone came back empty, having missed the targeted school of fish. Retained sets generally contained herring from about 27 to 34 cm (Fig. 1), representing a median age of about 5 to 6 years (Fig. 2). In contrast the released sets logically contained smaller fish, with modes in the length distribution at 23 and 27.5 cm (Fig. 1), or mainly 2 to 4 year old herring (Fig. 2). The relative proportions of spring and fall spawners in the catches approximately reflected the relative abundance of the two components (Fig. 2; LeBlanc et al. 2009).

Of the 101 sets for which bottom contact was examined using the vessel's net sensor, a clear indication of no bottom contact was evident for 90 sets (Table 2). Based on sensor monitoring, there were ten sets in which the observer indicated that bottom contact may have occurred, though no direct signs of bottom contact such as net tearing or capture of demersal species or bottom sediment were found. In the remaining set, evidence of bottom contact was noted based on net tearing and the capture of three lobsters. Sets with suspected or observed bottom contact all occurred in the >20 fathom zone.

Observers looked for evidence of the capture of demersal species in 104 of the 105 sets (i.e., regardless if contact was suspected based on sensor monitoring). Evidence was found only in the previously noted set, which captured three lobsters (Table 3).

Of the 17 sets that were released, dead herring were observed in seven sets (Table 4). In all of those cases only a few dead individuals were seen floating. Observers recorded whether scales were present on the water surface following the set release in 14 sets. Few scales were observed (index level 1 and 2) in all cases. Observers also noted the tightness of seine closing in nine of the released sets, finding that the seine was relatively loosely closed in all cases.

DISCUSSION

The findings in the study suggest that the purse seine might touch the bottom no more than 10% of the time, though direct physical evidence of contact was found in only one of 104 observed sets. This result logically follows from the fishers' avoidance of the bottom to minimize the risk of net damage. It is also consistent with the results of a qualitative analysis of impacts across a broad range of fishing gear that concluded that purse seines have a relatively low impact on habitat and non-target species (Chuenpagdee et al. 2003). Suspected bottom contact occurred only in the >20 fathom zone. Failure to detect contact in the shallower zone may

simply reflect either the smaller number of sets made there or enhanced caution on the part of the gear operator.

Indicators suggest that overall post capture survival may be high for herring released from sets containing a high percentage of undersized fish. Few dead fish were observed, suggesting little acute mortality. Furthermore significant amounts of fish scales, an indicator of injury and longer term mortality (e.g., Vold et al. 2009), were not observed. However, in the absence of a quantitative assessment of acute and delayed mortality, these results alone are insufficient to conclude that survival was indeed high. Nonetheless, inferred high potential survival of fish released in this fishery is also supported by the results of published experimental studies. Two studies have found that short term (on the scale of days) survival of herring that encounter but are not captured by fishing nets is generally high (Hay et al. 1986; Suuronen et al. 1996). A third study compared the 14-day survival rate for purse-seine captured herring in three treatments (each comprising two replicates): 1) without significant pursing of the net following capture, 2) with light pursing for a 10-min period, and 3) with strong pursing leading to "tightly crowded" conditions, again for 10 minuntes (Vold et al. 2009). Survival rates in these three treatments were respectively ~99%, ~98.3% and 72.1 to 98.2% confirming that survival of fish released from purse seines depends on the extent to which fish are crowded during the operations (e.g., Lockwood et al. 1983). Should light pursing of the net in the southern Gulf fishery observed in 2004 be the norm for this fishery, high survival of released herring may be generally expected.

It is possible that the results of our study underestimate true bottom-contact rates and post-release mortality of herring, if the fishers were more careful in deploying and manipulating their seines as a result of the enhanced level of scrutiny by DFO during the 2004 fishery (i.e., observer effect). Evidence for systematic changes in fishing practices in the presence of observers is typically sought by comparing characteristics of landings between observed and unobserved fishing trips (e.g., Benoît and Allard 2009). This was not possible here given that all 2004 trips in NAFO 4Tg were observed and that an inter-annual comparison would be complicated by differences in fish abundance and fishing locations between years. Nonetheless, we believe that observer effects concerning bottom-contact and herring post-release mortality rates are not likely to be strong in this study because enhanced caution when observed implies that there are reasons not to be cautious otherwise. First, lack of caution could be due to ignorance of the issues of habitat impacts and post-release survival. Given the long standing accusations by the fixed gear herring fleet, this is unlikely. Second, lack of caution may reflect a deliberate disregard for conservation; again an unlikely scenario concerning the survival of released fish given the purse-seiners interest in the sustainability of their fishery. Finally, there could be costs (time, fuel, etc) associated with enhanced caution. This is certainly not the case for gear interactions with the sea floor given that decreased caution should be associated with increased gear repair costs and foregone fishing opportunity. Furthermore, given the ease with which herring could be sampled via dip net when the purse seine was lightly closed, it is not clear that costs would be normally lower in operations with tighter seine pursing and higher ensuing mortality of released fish.

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Table 1. Summary of observations by set type from the fall 2004 herring seiner fishery off the northeast coast of P.E.I. (4Tg). The estimated weight of the catch (tonnes) is based on a visual estimate by the on-board observer.

	Zone (fathoms)			
	17 to 20		>20	
Type of set	Sets	Weight	Sets	Weight
Kept	9	835	64	3597
Released	4	250	13	509
Missed	0	-	15	-
Total	13	1085	92	4106

Table 2. Summary of observations of bottom contact during the fall 2004 herring seiner fishery in 4Tg.

	Zone (fathoms)		
Category	17 to 20	>20	Total
No contact	13	77	90
Observed on the net monitor[1]	0	10	10
Physical evidence of contact[2]	0	1	1
No observations	0	4	4
Total	13	92	105

[1] the observations were made by a single observer aboard the same vessel. Though the seine appeared to touch the bottom on the net monitor there was no direct evidence of bottom contact such as tearing or capture of benthic species.
[2] evidence of contact included tearing and capture of lobster (a benthic species).

Table 3. Summary of observations on lobster catches from the fall 2004 herring seiner fishery off the northeast coast of P.E.I. (4Tg).

Sets with lobster observed	Zone (fathoms)		Total number
	17 to 20	> 20	
No lobsters	13	90	103
3 lobsters	0	1	1
No observations	0	1	1
Total	13	92	105

Table 4. Summary of observations of herring mortality and injury indices and purse seine tightness for the 17 released sets during the fall 2004 herring seiner fishery in 4Tg.

Scale	Mortality [1] Observations	Injury [2] Observations	Seine tightness [3] Observations
Scale = 0	10	0	-
Scale = 1	7	7	8
Scale = 2	0	7	1
Scale = 3 to 10	0	0	0
No observations	0	3	8
Total	17	17	17

[1] Scale: 0 = no moralities observed to 10 = high number of mortalities observed

[2] Scale: 0 = no herring scales noted to 10 = large numbers of herring scales observed

[3] Scale: 1 = loose to 10 = very tight

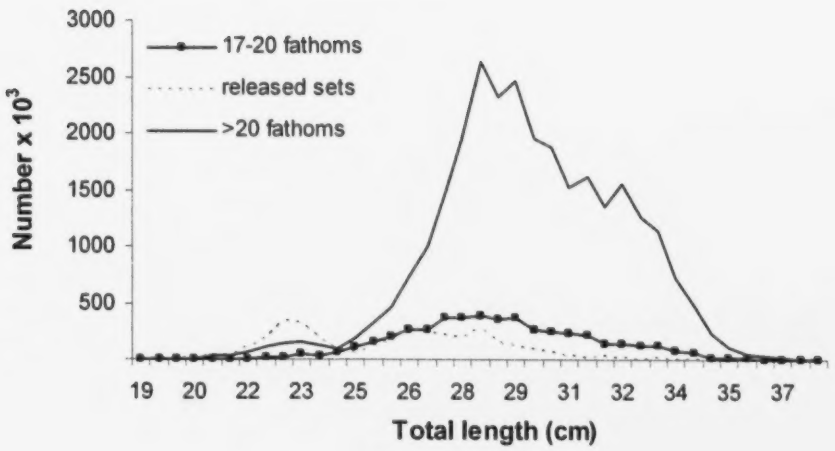

Figure 1. Number of herring at length (weighted by catch) from the retained sets in the two depth zones and from the released sets during the fall 2004 herring seiner fishery in 4Tg.

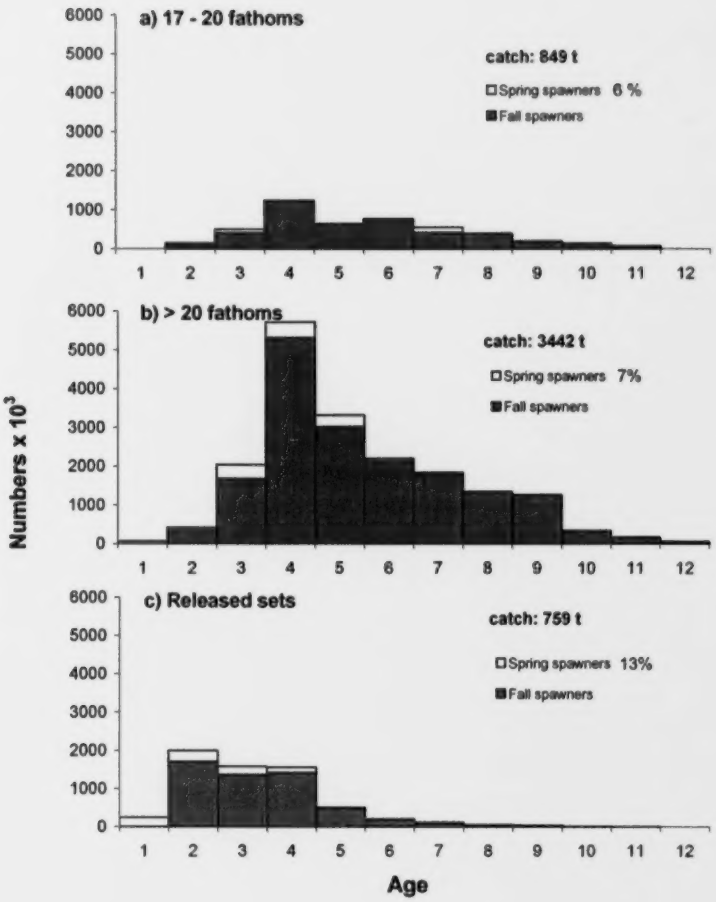

Figure 2. Catch at age of herring from the retained sets in the two depth zones and from the released sets during the fall 2004 herring seiner fishery in 4Tg.